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Safety of Central Venous Catheter Change over Guidewire for Suspected Catheter-Related Sepsis. A Prospective Randomized Trial

L. A. MICHEL, M.D., H. A. BRADPIECE, M.D.*, P. RANDOUR, M.D., F. POUTHIER, M.D.

*From the Surgical Service, Academic Hospital (U.C.L.) of Mont-Godinne and the Department of Surgery, University of Louvain-Medical School, Belgium; *Surgical Services, Massachusetts General Hospital and the Department of Surgery, Harvard Medical School, Boston, Massachusetts, USA*

We conducted a study to determine the safety of guidewire exchange of central venous catheters suspected of causing catheter-related sepsis (CRS). Out of a total of 146 patients studied prospectively 41 (28%) suspected of having CRS, were randomly allocated to have their catheters changed over a guidewire (group I) or replaced by a new contralateral venipuncture (group II). One hundred and five patients (group III) requiring only one catheterization served as a control group. Positive semiquantitative cultures (≥ 15 colonies per plate) of the catheter tip constituted a reliable index of CRS (positive and negative predictive value of 100%). No significant difference in catheter contamination rate and CRS rate was found between group I and II ($p = 0.13$) and between group I and II versus group III. Nevertheless, there were fewer problems of insertion in the guidewire group ($p = 0.03$). We conclude that changing a central venous catheter over a guidewire is as safe and has better patient acceptability than inserting a new one, as the proven CRS rate is low (2%) despite a high (27%) suspected rate.

KEY WORDS: Catheter-related sepsis - Guidewire exchange technique - Semiquantitative culture - Nosocomial infections.

Maki [1] suggested that over 25,000 patients develop device-related bacteremia in the United States annually. Included among those devices responsible for these infections are catheters placed to afford long-term central venous access. Several studies have reported catheter contamination rates of between 4 and 57% and catheter-related sepsis (CRS) rates of 1 to 10% of central venous catheters.[2-15]

In an attempt to prevent and/or treat catheter-related sepsis, the routine removal and replacement of central venous catheters at weekly intervals has been advocated.[16-19] Clinical assessment of the patient, with bacteriologic cultures of all suspected foci of infection and routine peripheral and central blood cultures is an alternative.[7] If no other source of infection is found and if the patient does not respond to antibiotic therapy, the catheter is removed and another is inserted after a 24- to 48-hour interval.

The two protocols mentioned involved the discomfort and hazards of a new percutaneous central venous catheterization with a documented 4% complication rate even when performed by experienced physicians.[13 20 21]. Furthermore the second protocol rarely allows an early clinical diagnosis of CRS and often requires intermittent interruption of intravenous solutions and drugs for 24 to 48 hours. Finally it should be pointed out that the majority of catheters removed for suspicion of CRS are in fact sterile.[7-9 12-14] Because of the disadvantages related to conventional central line placement, we and others [4 10 12] have elected to replace central venous catheters over a guidewire in cases suspected of CRS, in order to avoid patient discomfort and the risks of a new percutaneous catheterization. This paper reports the results of a homogeneous, prospective randomized trial of guidewire replacement of catheters versus de Novo catheterization.

Material and methods

Patient population

Over a six-month period, 146 patients admitted to a general surgery service required percutaneous catheterization of the internal jugular vein for total parenteral nutrition (TPN) (59%) or unsuitability of peripheral veins (41%) for prolonged intravenous infusion of fluid or drugs.

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Reprint requests: L. A. Michel, Surgical Service, Academic Hospital of Mont-Godinne, B-5180 Yvoir, Belgium.

Catheter placement and protocol of catheter exchange

The physicians who placed or changed the catheters were experienced with the procedure.[20] The chest and neck were prepared with povidone-iodine solution and the area was draped in sterile fashion. The insertion site was anesthetized with 1% lidocaine. All catheters were 5 Fr. gauge, 20 cm long and of polyvinyl chloride construction (Seldicath, Plastimed, Saint Leu-La Forêt, France). Occlusive dressings were used to cover the catheter insertion sites after the catheters had been fixed to the skin with sutures and povidone-iodine ointment applied. The catheter tip position was checked radiologically before initiating therapy. Dressings were changed every other day.

Patients developing unexplained pyrexia or clinical suspicion of CRS, had prompt catheter replacement. Criteria for suspected CRS were: *(1)* temperature greater than or equal to 38.5°C, *(2)* documented bacteremia, *(3)* overt swelling and tenderness at the site of insertion or purulent discharge at this site, *(4)* systemic signs of sepsis despite correct antibiotic therapy for documented distant septic foci. Patients who exhibited one or more of these criteria underwent routine evaluations, including at least two blood cultures obtained simultaneously from a peripheral vein and the central venous catheter; repeated urine, wound and sputum cultures. Bacterial cultures of the catheter insertion site were performed. All patients suspected of having CRS were randomly allocated by the drawing of an envelope to have their catheters changed over a guidewire, or removal and replacement with a contralateral internal jugular vein line. The technique of exchange over a guidewire is adapted from the original technique of Seldinger,[22] and entails threading a sterile stainless steel spring guide (USCI, 0.9 mm diameter, 45 cm long) through the catheter which is then removed. The new catheter can be threaded over the guidewire and the guidewire removed.

In this study, the distal segment (5 cm long) of the removed or exchanged catheter was cut off with sterile scissors and immediately transferred to the microbiology laboratory in a dry sterile tube and cultures were taken from it as described below.

Three groups of central venous catheters were available for comparison of infection rates (Table I): group I, catheters changed over a guidewire; group II, catheters removed and replaced contralaterally and group III, catheters placed in patients requiring only one catheter for the course of their treatment, this last group serving as a control.

Clinical information obtained at the time of catheter change and during the follow-up were recorded: purpose of catheter insertion, duration of catheterization, primary diagnosis at the time of catheter insertion (e.g., presence or absence of gastrointestinal malignancy) and administration of antimicrobial therapy or total parenteral nutrition via the catheter. To determine whether a relationship existed between the presence of infected foci and the frequency of positive catheter cultures, all proven foci of infection were recorded.

Microbiological methods

Catheter culture.—The distal segment of the catheter received in the microbiology laboratory in a dry sterile tube was cultured as soon as possible (within one hour of removal). This was done by drawing it across the surface of a chocolate agar plate supplemented with Isovitalex® enrichment*, according to the semiquantitative culture technique described by Maki.[7] The segment of catheter was then immersed in 5 ml of brain-heart infusion broth which was incubated at 36.5°C. Plates were also incubated at 36.5°C in a 10% CO_2 environment for 48 hours. Plates were examined daily for microbial growth and colony counts were performed by visual inspection after 48 and 72 hours of incubation. Broth was also examined daily and turbid broths were subcultured onto chocolate agar plates and then processed like the primary plates. Organisms recovered from primary plates and broths were fully identified. For Staphylococci, the identification was limited to Staphylococcus aureus or Staphylococcus of the coagulase-negative species. Plates and broths remaining sterile after 72 hours of incubation were considered negative and discarded. Results were obtained from broth culture and semiquantitative cultures for each catheter. Positive semiquantitative cultures of catheter tips yielding 15 or more colonies per plate were considered positive.[5 7]

Blood cultures.—Blood was inoculated for culture into an anaerobic vial containing trypticase soy broth in a CO_2 atmosphere and into an anaerobic vial containing reduced trypticase soy broth in a $N_2/H_2/CO_2$ atmosphere. A NR. BACTEC 660* using the principle of infrared spectroscopy of measuring the CO_2 generated as an end product of microbial metabolism was used to detect microbial growth in blood. With this technique the amount of CO_2 generated is inversely related to the amount of infrared light detected. This amount of infrared light is taken into account for the calculation of a growth index. A growth index greater than 35 was considered as positive. Positive specimens were Gram stained and subcultured on chocolate agar. The other vials were examined daily in the BACTEC 660 and incubated for ten days before being discarded as negative.

Definition of terms

Positive results of catheter-tip culture may be: the result of contamination during placement, manipulation of removal of the catheter; the result of colonization or hematogenous seeding during transient bacteremia from a distant focus; or the evidence of catheter-related sepsis. Many studies on the subject confuse and misuse these terms, so that results of catheter culture by the broth and semiquantitative techniques have to be evaluated in combination with strict definitions of those terms.[23]

"Contamination" will be defined as microorganisms being isolated from the catheter tip, but no other site. In these cases broth cultures will be positive, but semiquantitative cultures, negative.

"Colonization" differs in that organisms isolated from the catheter tip will previously have been isolated from a remote focus. The same organism is often also isolated in blood culture. In the case of colonization broth cultures are positive and semiquantitative cultures show no or low-density growth (one to less than 15 colonies per plate). This definition of "colonization" corresponds to what some Authors [5] refer to as "hematogenously seeded catheters" which are associated with a distant focus of infection containing organisms identical to those recovered from catheter and blood cultures.

Catheter-related sepsis (CRS) is defined as the presence of the same pathogenic organism on the semiquantitative culture of catheter and in blood cultures, whithout previous isolation from another focus.

Catheter broth culture is positive and semiquantitative culture shows high-density growth (≥ 15 colonies per plate). The sepsis resolves after removal of the catheter and, if necessary, appropriate antibiotic therapy. Assessment of this clinical evolution requires close supervision of the patient.[1 7 8 13]

Bacteremia is defined as being catheter-related when the same organism is isolated from two or more blood samples collected

* Becton-Dickinson, Rutherford, NJ, USA.

* Johnston Laboratories, Towson, MD, USA.

at different times with a catheter in place, and when no other primary septic focus other than the catheter is identified.

Statistical analysis

Ordinary parametric tests (Student's t test) were employed for comparison of continuous data. When indicated, non parametric methods for unpaired measurements were used (Mann-Whitney test). Comparison of discrete data was done by the Chi-square method with Yate's correction when appropriate of Fisher's exact test. Mean values are reported plus or minus the standard deviation.

The sensitivity, specificity, predictive values of positive or negative results of catheter cultures were calculated by standard methods.[24] For the purpose of computing these values, true-positive (TP), true-negative (TN), false-positive (FP) and false-negative (FN) results were calculated for broth culture techniqe and semiquantitative culture positive at two levels (i.e., 1 to 14 colonies or ≥ 15 colonies per plate). True positive catheter cultures were defined as those which were positive for the chosen technique (broth vs. semiquantitative) and selected result level (colony count 1 to 14 or ≥ 15) and which were associated with an episode of catheter-related bacteremia. True negative findings were those in which catheter cultures were negative for the chosen technique and level, and were not associated with episodes of catheter-related bacteremia. False negative findings were those catheter cultures which were associated with catheter-related bacteremia but were culture negative. False positive findings were those catheter cultures which were positive but not associated with an episode of catheter-related bacteremia. The sensitivity was calculated as TP/(TP + FN), the specificity was calculated as TN/(TN + FP), the predictive value of a positive result was calculated as TP/(TP + FP), and the predictive value of a negative result as TP/(TN + FN).

Results

Two-hundred internal jugular vein catheters were inserted in 146 patients for a total of 1720 days (mean 8.6 days, range: 3-40).

Complications of catheter insertion

Three patients sustained arterial puncture without severe bleeding. There were also three incorrectly positioned catheter tips. Five patients had prolonged procedures with repeated punctures.

Catheter-related sepsis (CRS)

Forty-one patients (28%) were suspected of having episodes of CRS and a total of 54 catheters out of 200 (27%) were changed for suspected CRS. One patient from group III was suspected of having CRS (Table I). His catheter was removed and not replaced as he did not require further vascular access. While the patients in groups I and II were randomly selected, both populations were clinically equivalent. There was no statistical difference between the two groups with regard to age, sex, white blood cell count, duration of catheterization, temperature at the time of catheter removal, diagnosis of GI malignancy, incidence of associated septic foci, administration of TPN or antimicrobial therapy.

Overall, 184 catheters (92%) yielded no growth either on plates or in broth cultures. Eighteen catheters placed in 13 patients were exposed to bacteremias from distant sites of infections unrelated to the catheters. The septic foci were, surgical wounds (thirteen catheters in nine patients), urinary tract infections (three catheters in two patients) and respiratory infections (two catheters in two patients).

Two catheters remained sterile. Four of the remaining 16 catheters yielded species in broth cultures and low-density colonization on semiquantitative culture (one to five colonies on the plate), that matched bloodstream pathogens and distant focus pathogens (Table II).

These four catheters were considered as having been "colonized" or hematogenously seeded. Eight other catheters demonstrated only positive broth cultures and did not result in CRS. They were classified as simply "contaminated".

Four other catheters were positive on semiquantitative culture (≥ 15 colonies) yielding respectively 20 and 60 colonies as well as confluent growth in two cases (Table II). All four catheters gave matching growth in broth, semiquantitative culture and in peripheral venous blood cultures (two also matched growth in blood drawn through the catheter before removal). In these four cases, other distant infected foci (wounds) were also found, but pathogens isolated from cultures taken from these foci were different from pathogens found on the semiquantitative culture, in broth culture and in blood culture. These four catheters produced bacteremias that subsided after catheter replacement: they were incriminated as the primary source of septicemia and diagnosis of true CRS was considered (2%).

Considering the uniform association of CRS and positive catheter culture (broth and/or semiquantitative), it is reasonable to regard a positive catheter culture as denoting local infection that could have been linked or would be linked with episodes of bacteremia (Tables III and IV). Predictive value of a positive catheter culture as an index of bacteremia was 100% for positive semiquantitative culture (either low or high-density colonization on the plate), versus only 50% for broth cultures. We determined also the sensitivity, specificity, predictive value of a positive or negative catheter culture as an index of true CRS (Tables V and VI). The predictive value of a positive catheter culture was greatest (100%) when the cutoff point for a positive semiquantitative culture was ≥ 15 colonies, by comparison with broth culture (25%) and semiquantitative culture with one to 14 colonies (50%). False positive (FP) diagnosis of CRS (Table VI) by broth culture or low-density colonization on semiquantitative culture (1 to 14 colonies) were eliminated when the cutoff point of ≥ 15 colonies per plate was designated as a positive semiquantitative culture result.[5 7]

As CRS incorporates in its definition the possession of a

TABLE I.—*Group of catheters changed for suspected catheter-related sepsis (CRS) and control group.*

# of catheters	Group I: Guidewire (22 patients)		Group II: de Novo (19 patients)		Group III: Control (105 patients)	Total
	initial	subsequent	initial	subsequent		
CRS suspected	22	4	19	9	1	55
CRS not suspected	0	22	0	19	104	145

TABLE II.—*Organisms recovered from catheters yielding growth in broth and/or on semiquantitative (SQ) plate, and CRS.*

Organism	Positive broth with SQ negative	Positive broth with SQ 1 to 14 colonies	Positive broth with SQ ≥15 colonies	
Coagulase-negative Staphilococci	4	0	0	
Corynebacterium species	1	0	0	
Bacillus cereus species	1	0	0	
Enterococcus	0	1	0	
Staphylococcus aureus	1	2	2	(2CRS)*
Klebsiella	0	1	0	
Serratia marcescens	0	0	1	(1CRS)
E. coli	1	0	1	(1CRS)
Total	8	4	4	

* Numbers in parentheses concern catheter-related sepsis (CRS) episodes.

TABLE III.—*Effect of using broth and semiquantitative (SQ) culture positive results as an index of bacteremia episodes.*

Techniques and levels of culture positivity	% Sensitivity	% Sensitivity	Predictive value (%) of	
			Positive resuts	Negative results
Broth culture	36	95	50	92
SQ 1 to 14 colonies	36	100	100	92
SQ≥15 colonies	18	100	100	91

TABLE IV.—*Values used to calculated data in Table III.*

Techniques and levels of culture positivity	No. of catheters that were			
	TP	TN	FP	FN
Broth culture	8	170	8	14
SQ 1 to 14 colonies	8	178	0	14
SQ≥15 colonies	4	178	0	18

TABLE V.—*Effect of using broth and semiquantitative (SQ) culture positive results as an index of catheter related sepsis (CRS).*

Techniques and levels of culture positivity	% Sensitivity	% Sensitivity	Predictive value (%) of	
			Positive resuts	Negative results
Broth culture	100	94	25	100
SQ 1 to 14 colonies	100	98	50	100
SQ≥15 colonies	100	100	100	100

TABLE VI.—*Values used to calculated data in Table V.*

Techniques and levels of culture positivity	No. of catheters that were			
	TP	TN	FP	FN
Broth culture	4	184	12	0
SQ 1 to 14 colonies	4	192	4	0
SQ≥15 colonies	4	196	0	0

positive catheter culture as a basic prerequisite [5 8 9], it is not surprising that sensitivity (TP/TP + FN) was 100% for the different techniques and result levels of catheter cultures.

Blood cultures were obtained by drawing blood from a peripheral vein and back through the catheter in the 54 instances of putative CRS episodes. Peripheral blood cultures were positive in 16 instances and blood cultures drawn via the catheters in six. Five of the six (83%) gave concordant results with peripheral blood culture results; in two, catheters were responsible for CRS and treated by removal and contralateral reinsertion; a further two contaminated catheters were changed over guidewire and the remaining catheter causing CRS was removed from a patient who did not require further vascular access.

Skin cultures yielded the same microbial species recovered from three CRS catheters (two grew Staphylococcus aureus and one grew Serratia marcescens). Non-pathogenic microorganisms were isolated from eight other sites of catheter insertion.

The microbiological profile of catheters giving growth in broth and on plate is contained in Table II.

Rates of positive broth cultures, positive semiquantitative cultures and CRS did not evolve with increasing duration of catheter placement.

Effect of catheter exchange in patients with suspected or proven CRS. Rate of catheter infection.—There was no significant difference in the frequency with which positive catheter cultures were obtained from subsequent catheters (Table VII) randomly allocated to be replaced by the guidewire exchange technique or new insertion. Three subsequent catheters placed by new venipuncture became the source of sepsis. One was removed and, as the indication for TPN resolved, it was not replaced and enteral antibiotic therapy was commenced. The remaining two were replaced again by contralateral venipuncture within 24 hours. There was prompt resolution of CRS without antibiotic therapy once these catheters were replaced. These two replaced catheters remained sterile.

CRS rate, as determined by semiquantitative cultures and blood cultures was identical in the groups of subsequent catheters placed by guidewire exchange technique of by new venipuncture ($p = 0.13$).

Safety of central venous catheter exchange over guidewire.—The significant difference between the two groups was that those undergoing guidewire exchange experienced fewer insertion complications (Table VII). Minor insertion problems were associated with five out of 28 catheters reinserted by a new puncture versus no problem in the 26 catheters changed over a guidewire ($p = 0.03$ by Fisher's exact test). The risk of transferring microorganisms to the new catheter changed over a guidewire did exist for two catheters that demonstrated positive broth culture and low-density colonization on semiquantitative culture. Subsequent catheter cultures remained, however, sterile.

Clinical variables associated with higher incidence of positive catheter cultures.—Two variables were analyzed as potential risk factors of positive catheter cultures: presence of gastrointestinal cancer and administration of TPN were more often associated with catheters from groups I and II versus group III ($p < 0.001$). However the variables were not significantly associated with increased frequency of positive catheter cultures in those groups.

TABLE VII.—*Randomized study of guidewire changes versus de Novo venipuncture catheter related sepsis.*

	Group I guidewire changes		Group II de Novo venipuncture		Group II One catheter
	Initial catheter n=22	Subsequent catheter n=26	Initial catheter n=19	Subsequent catheter n=28	n=105
Days inserted					
mean	9±6	11±8	7±5	10±7	8±4
range	3-16	3-40	3-24	3-28	3-19
Suspected CRS	22	4	19	9	1
Proven CRS*	0	0°	0	3°☆	1☆
Contamination-colonization	2	0	0	1	9
Insertion + problems**	2	0◇	1	5◇	3

* Positive blood cultures and semiquantitative culture ≥ 15 colonie.
** Arterial punctures, prolonged procedures and incorrectly positioned catheters.
° p=0.13; ☆ p=0.08; ◇ p=0.03; by Fisher's exact test.

TABLE VIII.—*Relation of positive results of catheter cultures to presence of septic foci.*

	Culture results	
	Negative	Positive*
No of catheters	184	16
No. of catheters associated with septic foci	101 (55%)	14 (87%)☆

* Positive cultures on broth and/or plate (SQ).
☆ Chi-square = 6.4; p<0.02.
Sensitivity: 87%; specificity: 45%; predictive value of presence of septic foci: 12%; predictive value of no septic focus: 97%.

The relationship between the presence of infected foci and the overall frequency of positive catheter cultures was found to be significant (Table VIII). Although the predictive value of the absence of septic foci was excellent (97%), the predictive value of the presence of septic foci was low (12%). However, no relationship was found between the presence of infected foci and the frequency of true CRS, either in the total series or in each subset.

Discussion

Before the development of the semiquantitative culture technique [7] most clinical microbiology laboratories used broth cultures of catheter tips in an attempt to detect contamined catheters. The broth culture technique yielded results that were highly variable. Unreliable results have marred previous reported series including our own.[8] Many other well conducted studies should have been the target of the same justified retrospective criticism.[2-4 6 11-13] At the time we conducted our earlier study the technique of semiquantitative culture was not yet widely accepted. We have shown that positive broth culture does not, by itself, indicate that the catheter is the primary source of infection (predictive value of positive result as an index of bacteremia 50%, predictive value of positive results as an index of CRS 25%), because microorganisms can lodge on the catheter during transient episodes of bacteremia from distant septic foci or at the time of catheter removal. Only when no other source of infection can be identified will the central line be designated as the origin of the sepsis;[5 8 9] but confirmation of catheter-related sepsis remains difficult. Some salient features of catheter-related sepsis which help distinguish it from other bacteremic syndromes are local phlebitis or inflammation at the catheter insertion site, lack of other source for bacteremia, resolution of febrile syndrome after catheter removal, and the presence of ≥ 15 colonies on semiquantitative culture of the catheter tip.[5 7 23] Whereas none of these criteria, and no other risk factors for CRS, specifically identify the catheter as the source of sepsis, the presence of one or several of these clinical findings should raise the possibility of CRS.

Previous studies [12 13 25] have used a clinical classification which was unsatisfactory because in many patients considered as having CRS, no organisms were identified on catheter cultures. Defining CRS on the basis of broth catheter culture is misleading too as it greatly exaggerates the incidence of CRS. Some studies [13 25] that did not incorporate a positive catheter culture as part of their definition of CRS, introduced a subtle, but confusing, distinction between catheter-related sepsis and catheter-associated sepsis. Such a distinction introduces false-negative (FN) results of CRS, as some catheters which are associated with CRS will be culture negative; which is unlikely if CRS is suggested clinically (e.g., septic episode resolving after catheter removal), unless the technique of catheter culture is incorrect of delayed. We and others [3-5 11] have chosen to avoid this source of false negative results by adhering to a strict definition of CRS. Thus it is not surprising that sensitivity (TP/TP + FN) was 100% using the semiquantitative culture technique.

The false positive (FP) diagnosis of CRS, was probably eliminated in our study for two reasons, the first being an overall low level of CRS (2%), due to the protocol of central venous catheter insertion and early replacement, if episodes of CRS were suspected. The second reason is related to the systematic use of semiquantitative culture technique, again in combination with a strict definition of CRS (having a positive catheter culture being a prerequisite). False positive diagnosis of CRS (Table VI) bas-

ed on broth culture results or taking into account low-density colonization on semiquantitative cultures (1-14 colonies per plate), were eliminated when the cutoff point of ≥ 15 colonies per plate was designated as a positive result. The predictive value of a positive semiquantitative culture as an index of CRS was then 100% (versus 25% for broth) (Table V). Our results follow and corroborate the trend of those reported by other investigators dealing with peripheral catheters [7] or all types of intravascular catheters (including pulmonary artery catheters),[5] and routine use of semiquantitative culture technique. Investigators who endorsed the use of semiquantitative culture technique, but who did not incorporate positive catheter culture as part of their definition of CRS,[25] found that the predictive value of positive semiquantitative culture was low, despite good sensitivity and specificity. They assumed that predictive value would be better in patient populations with a higher prevalence of CRS. As demonstrated by our results and by others,[5] predictive value is high even in patient populations with a low prevalence of CRS; which is in fact the interesting feature of semiquantitative culture technique for clinical use.

An important problem highlighted again in our study and reported by others [3 4 8 12 13] is the high incidence of unnecessary catheter removal for suspected catheter-related sepsis. Over 90% of catheters removed for suspected CRS were shown by clinical and microbiological evaluation not to be the cause of sepsis. Changing catheters over a guidewire is simpler and safer than catheter insertion at a new site for hypothetical CRS. Three non-randomized studies [4 10 14] have demonstrated that this procedure presents a low risk for catheter cross contamination. One prospective randomized study [12] did not incorporate the use of semiquantitative culture of catheters but a fastidious quantitative culture technique instead. It demonstrated the same advantages of guidewire exchange technique, plus the fact that there were significantly fewer problems of insertion in the guidewire group. However, the guidewire procedure resulted in subsequent sepsis in one case, because pathogens were probably transferred to the new catheter. This occurred only when there were more than 1,000 colony-forming units on the catheter tip.

The guidewire exchange technique is not recommended for treatment of a infected catheter or CRS. Our results confirm, however, that this simple and safe technique can be used as a temporary measure when CRS is suspected. Therefore, if the semiquantitative culture from a catheter tip following a guidewire exchange is positive, the new catheter should be removed and another one placed at a different site after a 24-hour interval. We follow the same recommendation if the catheter insertion site is obviously infected. It should be stressed that the reliability of this technique does not mean that the strict protocol of central venous catheter management, especially if used for TPN, can be violated indiscriminately. All the necessary precaution to minimize risk of CRS should continue to be enforced. But considering the relative safety and ease of central venous catheter exchange over guidewire, we added to our protocol of management an elective fortnightly catheter change over a guidewire.

It is important to point out that the fibrin sheath that forms around most vascular catheters can occasionally become colonized by bacteremic seeding from distant infections. A positive semiquantitative catheter culture will probably ensue. This circumstances should not necessarily be considered a false-positive result of the semiquantitative technique, because such a colonized catheter can perpetuate or initiate septicemia and CRS. Short of surgically removing catheter tips through a sterile field, it is unlikely that colonization can be distinguished with complete reliability from simple contamination during removal.[12]

When guidewire exchange is considered for questionable CRS, the removed catheter could advantageously be examined by direct Gram staining as recently reported.[5] This simple technique allows diagnosis of CRS to be highly suspected or high-density colonization proved within minutes after removal of the catheter. It does not require overnight incubation as with semiquantitative culture. The correlation between the results of catheter tip-Gram stain and semiquantitative culture is excellent.[5] This technique should enable the physician to recognize the small group of highly colonized catheters that should be replaced by new venipuncture at another site instead of leaving the catheter changed over guidewire in place. To follow such a recommendation requires a competent, accessible and interested microbiologists. Combination of guidewire exchange technique and catheter Gram stain is probably the fastest way of establishing whether sepsis is catheter-related, while retaining vascular access.

Conclusion

Adhering to a strict definition of CRS has demonstrated the clear advantage of semiquantitative cultures as a means of predicting which septic incidents are catheter related. The changing of a catheter over a guidewire, when CRS is suspected, has been shown to be at least as safe with regard to septic complications as a new venipuncture. However, we strongly recommended that catheters changed over guidewires should always be cultured, and if positive, should be replaced by a new puncture at another site.

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